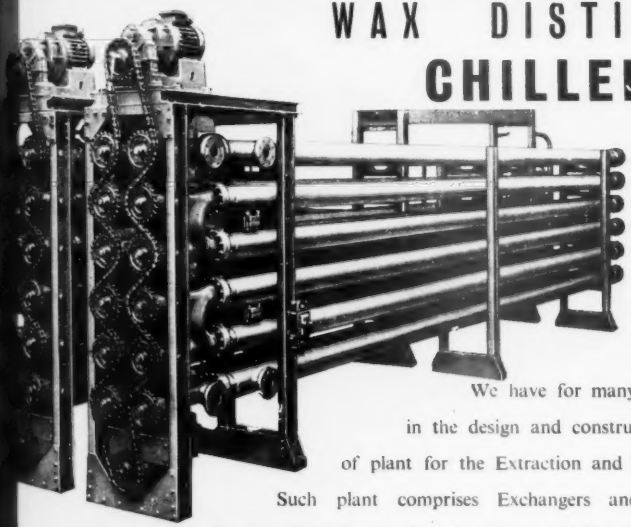
INSTITUTE OF PETROLEUM REVIEW

6. No. 62, FEBRUARY, 1952. Price 1/6d. Annual Subscription: Fifteen Shillings

CRAIG
WAX DISTILLATE CHILLERS



We have for many years specialised in the design and construction of all types of plant for the Extraction and Refining of Wax. Such plant comprises Exchangers and Chillers, High Pressure Filter Presses, Sweating Stoves and Moulding Presses.

We specialise in all types of Heat Exchange Equipment including exchangers, condensers, coolers and reboilers.

A. F. CRAIG & COMPANY LIMITED

CALEDONIA ENGINEERING WORKS

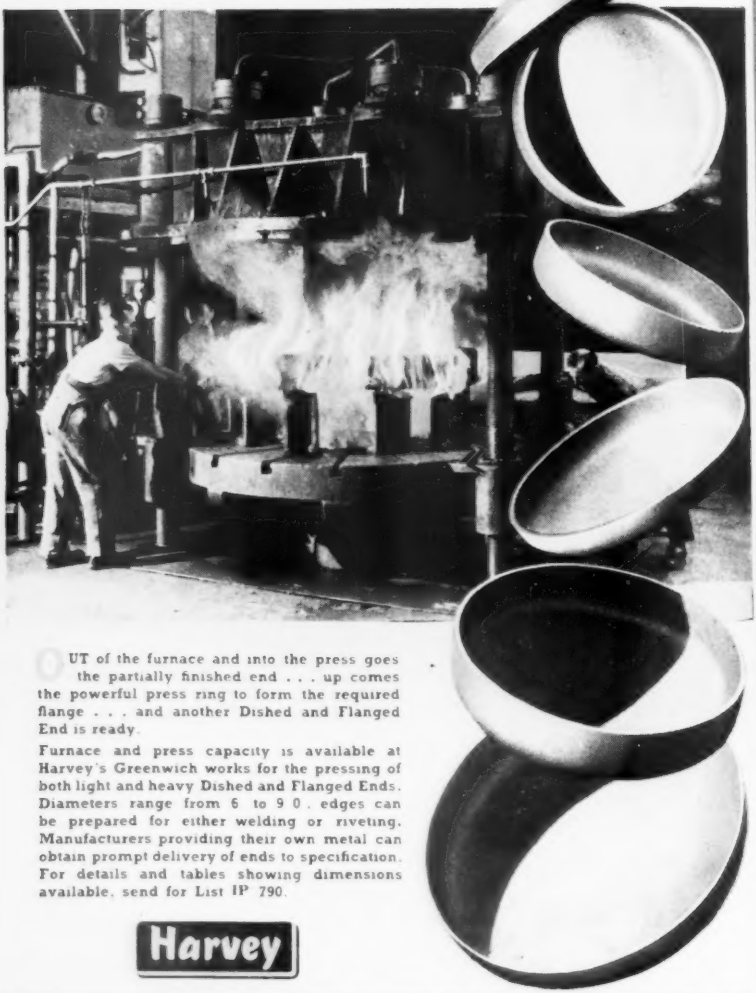
PAISLEY SCOTLAND

London Office 727, Salisbury House, London Wall, E.C.2. *Telephone*: MONARCH 4756

PUBLISHED BY THE INSTITUTE OF PETROLEUM

26, Portland Place, London, W.1. Telephone No. LANgham 2250

DISHED ENDS ?



OUT of the furnace and into the press goes the partially finished end . . . up comes the powerful press ring to form the required flange . . . and another Dished and Flanged End is ready.

Furnace and press capacity is available at Harvey's Greenwich works for the pressing of both light and heavy Dished and Flanged Ends. Diameters range from 6 to 9 0 . edges can be prepared for either welding or riveting. Manufacturers providing their own metal can obtain prompt delivery of ends to specification. For details and tables showing dimensions available, send for List IP 790.

Harvey

G.A. Harvey & Co. (London) Ltd. Woolwich Road, London, S.E.7

INSTITUTE OF PETROLEUM REVIEW

Hon. Editor: F. H. Garner, O.B.E., Ph.D., F.R.I.C.
Hon. Associate Editor: E. B. Evans, M.Sc., Ph.D., F.R.I.C.
Editor: George Sell

No. 62 FEBRUARY, 1952 Vol. 6

CONTENTS

World Petroleum Developments, By C. A. P. Southwell 33
Council Commentary 39
Personal Notes 40
Modern Techniques in Petroleum Testing VII. The Estimation of Sulphur In Petroleum, By D. Harvey 41
Oil's Contribution to the U.K. Fuel Economy 47
Around The Branches 49
Trinidad Petroleum Industry in 1950 52
U.K. Petroleum Consumption and Supplies 56
Forthcoming Meetings 58

WORLD PETROLEUM DEVELOPMENTS *

By C. A. P. SOUTHWELL,† M.C. (Fellow)

It is well that those who are engaged in various branches of the petroleum industry should, once in a while, relax from their own special part in it and take stock of what has been, and is happening in the world petroleum industry as a whole.

It is difficult to deal with this subject without drawing heavily on statistics, but figures can be tiresome and they have therefore been reduced to a minimum.

Events in Persia are making a substantial change in the world oil position. Over 30 million tons a year of production and 24 million tons a year of refining capacity cannot be cut off without the influence being worldwide, but the matter is still *sub judice* and it is better not to speculate on this unfortunate development at the present time.

Figures are not available to show the position of the world petroleum industry relative to other world industries; it is, however, known that in the United States it takes fourth place after agriculture, railways, and public utilities. It is also known that substantially more than half the oil so far produced in the world has come from that country and in spite of this and the fact that the United States production recently reached a record figure, yet proven reserves there rose in a year by 150 million tons to a total of 4,000 million tons in 1950.

But the picture is changing. An

*Delivered by G. Elias of Kuwait Oil Co. on behalf of C. A. P. Southwell, President of the Institute, to the Stanlow Branch, October 17, 1951.

†Kuwait Oil Co. Ltd.

Fig. 1

increasing amount of the world's oil is coming from the Middle East, remote from the world's principal areas of consumption. (Fig. 1.) The demand for petroleum throughout the world increased by 14 per cent in the year ending mid-1950. Of this increase less than half was met by the United States. The world's chief oil exporters: Venezuela, Kuwait, Iraq, Persia, Saudi Arabia and Qatar, accounted for 31 per cent of the world's oil supply while consuming only 9 per cent, leaving 330,000 tons a day for the importing countries, but if the cost of transporting oil is considered, it is found that the line of equal cost from American Gulf and from the Persian Gulf cuts Italy lengthways and this line falls considerably short of Western European ports for oil from the Persian Gulf. However, the United States no longer has surplus production; she is becoming increasingly dependent on imports, which now comprise about 10 per cent of her consumption. It should be noted that some of this oil even comes from as far afield as the Middle East.

Nor is the world supply position likely to revert to its former state as 46 per cent of the world's proven reserves lie in the Middle East and only 30 per cent in the United States. A feature of the history of the industry has been that new discoveries have maintained forward reserves at something like a 20 year level although world consumption has bounded upwards, as an example from 265 million tons a year in 1938 to 520 million tons a year in 1950. Nevertheless, the position of oil reserves is not causing great anxiety.

The development of crude oil production in the Middle East has made itself felt in many ways. Reference has already been made to the longer haul to Western Europe, but also this area of production is far from the manufacturing industries which supply its needs and to the present long deliveries of most of the equipment and materials used by the oil industry must be added, in the case of the Middle East, a long and costly voyage out, factors which must be met by long forward planning.

The long haul of oil from Middle East to Western Europe and, as mentioned before, to the United States has brought into use an increasing number of tankers of around the 30,000 ton mark. This development has, in turn, required that marine facilities at both the loading and unloading terminals be built to handle vessels of this size. At Kuwait's new port of Mina al Ahmadi super-tankers are constantly coming in and being loaded in 10-11 hours and, in fact, the overall time there for all the port operations of these larger tankers is frequently no more than 18 hours.

A further burden which has fallen on the companies operating in the Persian Gulf has been the need to provide all the necessities and amenities to allow of communities settling in sparsely inhabited areas, in some cases in arid desert.

To some extent these factors are offset by the very prolific fields found in the Middle East, resulting in high average yields, over 660 tons a day per

well, as against 30 tons a day in Venezuela and less than 2 tons a day in the U.S.A.

Recent years have also shown a radical change in the policy of locating new refineries. No longer are seen vast refineries being built in or near the big oil exporting countries, a policy which built the great refineries of Aruba, Curaçao, and Abadan. Now there is great activity in refinery construction in the industrial countries which are the biggest importers of oil, formerly importers of oil products but now of increasing quantities of crude.

In the United Kingdom the refinery capacity of 2.3 million tons a year of 1939 has been so stepped up since the war that it is scheduled to be 20 million tons in 1952, an expenditure of something like a £100 million being involved. By 1952 Italy will have doubled her 1948 refinery capacity (4¼ to 9.7 million tons) and other countries of Western Europe have similar stories to tell. The total present refinery capacity of Western Europe is about 60 million tons a year, about 10 per cent of the world's total.

Having dealt briefly with the present general trend in the world petroleum industry four specific areas and projects which are especially notable for their post-war development will be described in some detail. These are Canada, the natural gas industry in the United States, the Trans-Arabian Pipeline, and Kuwait.

Canada

Canada is a relatively large consumer of petroleum products. In 1949, while the United States consumed over 500 gallons per inhabitant and Great Britain 85, Canada's figure was 300 so that the rapid development which has taken place in her own production has been a tremendous contribution to her economy.

Canada's oil production comes from Alberta where, for the ten years ending 1947, her production was fairly steady, averaging a little over 1 million tons a year. This has since shot up. The production of 3½ million tons in 1950 at a gross value of over 80 million dollars, and an estimated 6 million tons in 1951 give some indication of the rate of development.

This results from an equally phenomenal drilling activity, about half a million feet annually during the war years reached 4,330,000 feet in 1950, and the drive for more production and new fields is shown by the drilling of 752 wells in the first nine months of 1951. Of this number 202 were abandoned, which is significant in showing the confidence and determination to open up further areas, as is also the existence of over 100 geophysical parties now working in Alberta alone. These geophysical parties are using the seismic, gravity, airborne, and ground magnetometer methods.

The high expenditure on exploration and development is certainly bringing in returns and under this heading it is expected that 215 million dollars will be spent in 1951. As a result of this expenditure Alberta was recently producing at the rate of 22,000 tons a day of crude, and new discoveries are constantly being made. New oil and gas discoveries during 1951 are running about 35 per cent above those of the previous year. In consequence of this vast expenditure and activity, proven reserves in Alberta and Western Canada generally are now given as being over 200 million tons, and of this total 80 million tons lie in the Redwater field and 40 million tons at Leduc.

Now the main difficulty facing the Canadian oil industry is that of transporting the production. In the foregoing it was mentioned that recently the production has been running at 22,000 tons a day but it will only average a bare 17,000 tons a day throughout the year, this largely being due to the cessation of traffic on the

lakes during the winter months. So the position is reached that while Canada's potential production is 57 per cent of her requirements, yet mainly because of transportation problems only 37 per cent of requirements could be met during 1951 from indigenous production.

Refinery capacity in Canada is a little over 50,000 tons a day and the greater part of this lies in Eastern Canada. The completion, therefore, of the inter-provincial pipeline from the Leduc area to Lake Superior has been of the greatest importance in providing an outlet for Alberta's crude.

The present view is that Toronto will be the eastern limit for the economic movement of Alberta's oil. There is, however, a big market on the Pacific Coast, shipments of crude and refined products from California to the Pacific Northwest being in the neighbourhood of 30,000 tons a day. It is understood that the construction of a pipeline from Alberta to British Columbia will not be long delayed.

Now there is something else in Alberta which is of great interest to the oil world. This is the McMurray bituminous sand region, these bituminous sands being found outcropping along the Athabaska River and its tributaries. These oil-soaked sands, which vary up to 200 feet in thickness, cover an area variously estimated at between 15,000 and 30,000 square miles. It is claimed that the oil reserves in this area are four times the known world reserves and these bituminous sands carry comparatively little overburden. It is said that the Alberta Government would very much like to see British capital going in to develop this area, and in fact Alberta oilfields generally.

Incidentally, these bituminous sands have a high sulphur content, estimated to be capable of yielding 900,000 tons of sulphur a square mile, this sulphur being capable of being extracted at a cost representing a quarter of the present world price.

The product of the processed bitumen is a blend of gasoline and gas oil and the sand is now being mined by the opencast method and taken to the nearby experimental extraction plant, where separation of the oil from the sand is by the hot water method, but other processes are under consideration.

Natural Gas Industry in the United States

The second major development in the western hemisphere is the natural gas development of the North American continent, especially in the United States. This has been one of the most spectacular developments of post-war years on the American scene. It is again a problem involving the solution of transportation difficulties. Outlets have now been provided for what was largely an unused source of energy and natural gas is now playing a very important part in American economy. This is clearly illustrated by the fact that the United States natural gas market is expanding at about twice the rate of the petroleum products market. It would have expanded still more but for the shortage of steel which has delayed the construction of pipelines.

In 1950, 7,600 miles of major gas pipelines were constructed and at the beginning of this year applications to build nearly 16,000 miles were under consideration. A 34-inch gas pipeline completed recently, 500 miles long, takes natural gas produced in Texas right into the San Francisco area. This is an extension of a system already 1,600 miles long. An even more spectacular project has been the commissioning of a pipeline to transport gas from the Rio Grande valley right into the city of New York. This line is 1,840 miles long and is building up to a delivery of 250 million cu. ft. a day. The ultimate designed capacity of the line will be 500 million cu. ft. a day. The matter of oil reserves was referred to earlier in this paper and in this connexion it is interesting to note that in the

United States 53 per cent of the total hydrocarbon reserve is in the form of natural gas.

Besides the use of natural gas as a fuel it is increasingly becoming a vital raw material in industry. A recent example of this is to be found in a plant at Eldorado, Arkansas, using nearly 40 million cu. ft. of gas a day in the manufacture of nitrogen products. These include the making of anhydrous ammonia, proprietary nitrogen solutions, sulphate of ammonia, etc., and a well-known chemical firm in the U.S. has just commissioned a large plant using natural gas and butadiene as an initial step in the production of nylon for which there is such a big demand these days.

The Trans-Arabian Pipeline

Turning now to the Middle East, a post-war development of major importance has been the construction of a pipeline from the Persian Gulf to the Mediterranean.

This Trans-Arabian Pipeline—Tapline for short—now carries a substantial part of Arabian-American Oil Company's production from its Saudi-Arabian fields, near the coast of the Persian Gulf, through a 30/31 inch pipeline, 1,068 miles long, to a new oil loading terminal at Sidon in the Lebanon. This line took 32 months to lay, i.e., an average of about 1 mile a day. In fact, at the time the author visited the job, they were laying two to three miles a day and the striking feature of the work was the comparatively few men actually engaged in stringing and welding the line, although of course there was a formidable organization behind it.

For the construction of the pipeline a new port came into being, Ras el Mishab, on the Persian Gulf 125 miles from the nearest habitation. Deep water lay 3 miles off shore and here it was necessary to construct an artificial island at which ships could berth and from which 225,000 tons of pipe and equipment were brought ashore by the "sky-hook," an aerial rope-way with self-propelled cars. The purpose of using a combination of 30 and 31 inch pipe was to allow the former to be nested in the latter during ocean transit. This policy resulted in virtually half of the pipe being freighted from the U.S. free of charge. In the pipeyard at Ras el Mishab the 30-inch pipes were extracted from the 31-inch and an automatic welding machine welded three joints of pipe into a 93-foot section. These sections were then transported along the route of the pipeline on 50-ton trucks. Sixty thousand tons of pipe were unloaded at the Mediterranean end and it was the western section, of course, which passed through the mountainous country.

The pipeline, which cost $230,000,000 was commissioned in December 1950 and took nearly 650,000 tons of crude to fill it; but the first liquid to be pushed along the line, ahead of the oil, was a 200-mile long plug of water, separated from the oil by a go-devil carrying radio-active material as a tracer, detected by geiger counters.

There are six pump stations on the line and the present capacity is about 40,000 tons a day but it is the intention to double the number of pump stations and increase the throughput to 65,000 tons a day.

At Sidon, the Mediterranean terminal, deep water lies a mile off shore and here are located four loading berths, two of which are fed by a 30-inch loading line each and the other two by 20-inch loading lines, giving a total loading capacity of some 10,000 tons an hour.

This pipeline offsets the use of some 65 T-2 tankers by delivering crude to tankers at a point 3,500 miles nearer to a big part of its market, and the 40,000 h.p. required to pump the crude requires rather less than 200 tons of fuel as compared with nearly 3,000 tons of fuel which would be required to take an

equivalent quantity of crude round to the Mediterranean by sea.

Kuwait

The last example of post-war development in the world petroleum industry is the case of Kuwait, which is now playing such a big part in the rapidly increasing production from the Middle East.

Work started in Kuwait in 1946 and in August, 1951, Kuwait Oil Company's production was at the rate of just over 700,000 barrels a day, which is the equivalent of 35 million tons a year, so that Kuwait is producing at a higher rate than Persia before the crisis.

Kuwait is a comparatively small state in relation to neighbouring countries. Burgan field is the location of the company's production. From here there are pipelines to Ahmadi town which has recently been constructed and is still being developed by the company, and where is situated the main storage tank farm. This town is built on a ridge some 7 miles from the coast and the oil gravitates from the tanks down 22- and 24-inch gravity lines straight on to the jetty at the new port of Mina al Ahmadi, and into the ships without any further pumping. This jetty, Fig. 2, is located near the steam power station and evaporating plant and the refinery. Refined products are not exported from Kuwait. The refinery has a throughput of about 3,500 tons a day and its purpose is to provide the products required for local consumption and to provide bunkers for tankers which load crude at the port. As Kuwait has no fresh water supply of its own a sea-water evaporating plant has been constructed and this has an output of some 600,000 gallons a day of fresh water.

When a well is completed in the Burgan field it is not necessary to dismantle the derrick and all the machinery and then transport it by lorry to the next site. Eight or ten D-8 Caterpillar tractors are hooked on and the rig is skidded to the next location to be drilled, in some cases this being nine or ten miles away. This procedure means that within a comparatively short time, in fact measured in hours, a rig can bring a well into production, be skidded to its next location and spud in a new well. In the Burgan field are a number of gathering centres to which the oil and gas come direct from the producing wells in the vicinity. The

Fig. 2. The jetty at Mina al Ahmadi

oil is separated from the gas in a number of stages beginning at 425 p.s.i., and the oil then goes into tanks from which it is pumped to the main storage tank farm at Ahmadi.

The jetty is one of the largest of its kind in the world. The oil and cargo jetties, were completed in December, 1949, and took only 18 months to construct. The long arm is the oil jetty and there is accommodation for six tankers. There is reason to believe that more of the new super-tankers are using this port than are going to any other port in the world. The shorter arm of the jetty provides two berths, one on the seaward side, one on the shoreward side, and these berths are used for tying up cargo ships which bring in the company's supplies.

★ ★ ★

COUNCIL COMMENTARY

The President was with us once more to take the Chair at the Council meeting held on December 12th and there was a good attendance of members.

There had been no decision on the nomination of a President for 1952-3. The particular President's Committee considering this matter naturally awaited the return of Mr Southwell from Kuwait before coming to a final recommendation to Council.

It has been suggested by the Publications Committee that a Summer Meeting of the Institute should, if possible, be held in 1952, such a meeting catering for both the technical and social requirements of members. The suggestion has now been considered by Council and the idea approved in principle. There was considerable discussion on the question of where such a meeting should be held and Manson House, seaside resorts and various university towns were considered. It is hoped to make arrangements in time for a summer meeting this year, and the possibilities are being explored. In any case, it is hoped to hold such summer meetings in future years even if one cannot be arranged for 1952.

Various constitutional questions were also discussed at considerable length and these included considerations of eligibility for membership of the Institute, grades and classification of membership.

ANNUAL REVIEWS, VOL. XI

Volume eleven of the Institute of Petroleum's *Reviews of Petroleum Technology* has just made its appearance and contains a valuable and critical record of the progress made in the science and technology of petroleum during the year 1949. As in previous years, the authors have done much searching of literature to examine the material on which their reviews are based and the volume contains references to nearly 3,000 technical papers and articles.

Although 1949 is the year mainly covered, there are instances where in previous years the information available has been insufficient to warrant a review covering one year only. Thus, the present volume reviews plant instrumentation for the period 1947 to 1949, crude oils for the same period, and insulating and hydraulic oils and bitumen for the years 1948 and 1949.

Price of this 280-page book is 27s 6d, and Institute members can obtain one copy for 22s 6d.

★ ★ ★

A Distillation column 136 ft long, 10 ft wide, and 14 ft 6 ins high, weighing 55 tons, was recently transported by road from London to Grangemouth, in Scotland, The column, which was carried on two trailers spaced approximately 60 ft apart, was manufactured by G. A. Harvey & Co. (London) Ltd. for Forth Chemicals of Grangemouth. Traction was provided by two 45-ton tractors.

PERSONAL NOTES

A. Limb

W. H. Senneck

W. F. List

L. M. Broadway

Alonzo Limb has been appointed sole managing director to C. C. Wakefield & Co., following the retirement after 45 years' service of **Walter H. Senneck,** with whom Mr Limb previously shared the responsibilities of the post. Mr Senneck retains a seat on the Board.

Other Castrol board changes include the appointment of **William F. List,** M.Inst.Pet., and **Leonard M. Broadway,** as assistant managing directors. Mr List has spent the majority of his 41 years with the company overseas, returning to the U.K. in 1946 and becoming a director a year later. Mr Broadway was appointed a director in 1947.

William Arthur Gruse, Administrative Fellow of the Petroleum Refining Fellowship at Mellon Institute, has received the Pittsburgh Award of the Pittsburgh Section, American Chemical Society. This award recognizes the important advances made under his direction in the chemistry of refining petroleum. Among the many offices held by Dr Gruse is that of Chairman of the Committee on Automotive Engine Oils of the ASTM.

J. Scott, deputy manager, Scottish Oils and Shell-Mex Ltd., and secretary of the company in Scotland, has retired. He joined the British Petroleum Co. in 1913.

Dr A. Ivanoff, F.Inst.Pet., has become Chairman of the British Hydromechanics Research Association.

Another member of Anglo-Iranian's former staff in Persia on whom a New Years' honour was conferred (see *IP Review*, January 1952 p. 2) was Mrs **Dorothy Ridge,** matron of the company's Abadan hospital, who received an M.B.E.

W. Robert Sharp, M.Inst.Pet., was recently appointed chief engineer to Fina Petroleum Products Ltd.

Dr A. C. Fieldner, chief fuels technologist of the U.S. Bureau of Mines, was recently presented with an honour award by the Washington Society of Engineers. This award in recognition of outstanding professional achievement has been in existence for many years but has been presented only four times previously.

R. B. Southall, member of Council, has been appointed by the Minister of Education to be a member of the Central Advisory Council for Education (Wales) for three years from December 1, 1951.

MODERN TECHNIQUES IN PETROLEUM TESTING

VII. THE ESTIMATION OF SULPHUR IN PETROLEUM

By D. HARVEY*

Notwithstanding the number of sulphur compounds known to be present in petroleum, normal routine analysis is restricted to the determination of total sulphur, mercaptans, elemental sulphur and hydrogen sulphide. In exceptional cases thiophene and carbon disulphide are estimated, but these are rarely, if ever, present in natural petroleum.

Total Sulphur

Standard methods for the determination of total sulphur are the lamp method (IP 107/51), the bomb method (IP 61/51) and the quartz tube method (IP 63/51(T)). The first of these is usually applied to the more volatile fractions although methods at present in use may be extended to gas oils after their dilution with a lighter oil of known sulphur content. The bomb method in which the sample is burned with oxygen at 25/40 atmospheres pressure is reserved for lubricating oils, bitumen, etc., whilst in the quartz tube procedure, the sample is vaporized in air and passed over quartz chips heated to 950-1000°C. This method is recommended for use when the bomb apparatus is not available.

In earlier forms of the lamp method, the wick was fed from a reservoir containing the oil sample and the products of combustion were led via the chimney to a train of wash bottles wherein the sulphurous compounds were absorbed for subsequent estimation. Certain disadvantages of this simple system have been remedied by later designs. For example, Javes[1] has described a lamp now adopted as standard which has greatly extended the method and increased its accuracy. The oil is burned in a closed system which allows the use of purified air, oxygen-air or oxygen-carbon dioxide mixture. The burner is formed from two concentric glass tubes and in order to improve and accelerate the rate of combustion, primary air is led to the inner wick tube. The products of combustion are absorbed in sodium carbonate solution and the sulphurous compounds formed are determined by titration, gravimetric or turbidimetric procedures.

Mapstone[2] has suggested a modification whereby the chimney is constricted at its base to produce a Venturi effect and so increase the turbulence in the combustion zone. This modification enables 19 grams of gasoline to be burned in an hour. Hindin and Grosse[3] employ a reservoir designed to provide a variable hydraulic head whereby the long wick path may be reduced. This permits the application of the lamp technique to fractions boiling up to 500°C. The reservoir is electrically wound and heat may be applied to prevent solidification of high melting point samples.

A variation of the quartz tube method described by Hagerman[4] employs a stainless steel tube vertically in an electric furnace heated to 900-1000°C. The tube is packed with quartz beads and coarse clean sand, supported on a perforated disk and packed in 6 to 8 alternate layers. A current of purified air is drawn through the apparatus and the sample is dropped slowly on to the porous material whereby it is decomposed and the sulphurous gases formed estimated by volumetric or gravimetric procedures. Obviously this method will not apply to compounds which contain nitrogen, phosphorus, halogen, barium, calcium or metals which form stable compounds with sulphur at the operat-

*I.C.I. Ltd., Billingham Division.

Fig. 1

ing temperature, or to light hydrocarbons such as gasoline.

Wilson and Straw[5] have made an improvement on Hagerman's procedure in which the stainless steel tube is replaced by one of quartz packed with a catalyst consisting of 10 per cent vanadium pentoxide on alumina. The method has been successfully applied to the determination of sulphur in gasoline, high boiling hydrocarbon oils, and solid combustible materials such as coal.

One of the most recent and time saving methods is that of Zermany[6] who determines sulphur content by an X-ray procedure. The instrument (Fig. 1) employed measures the relative absorption of two samples in terms of the amount of aluminium necessary to be added to one-half of a divided X-ray beam in order to compensate for higher absorption in the sample in the other half. A two-bladed synchronous motor-driven "chopper" alternately interrupts and divides the beam of X-rays, one half passing through the sample and the other through the standard. The rays which pass through the cells impinge alternately on the left and right halves of a fluorescent screen where the radiation is converted to light. This passes through a light tunnel to a multiplier photo tube and is converted into direct current whose magnitude and direction depend on the relative intensities of X-rays transmitted through the sample and the standard. This direct current is measured by means of a micro ammeter and by referring the dial reading to an appropriate calibration curve, the concentration of sulphur in the sample may be determined. Variations in the carbon/hydrogen ratio of the oil samples produce little or no error in the sulphur determination, the accuracy of which is stated to equal that of current standard methods.

Mercaptans

For the detection of mercaptans the well-known "Doctor" test is still applied extensively and for their determination, titration with standard silver nitrate is the generally accepted method. The progress and end-point of the titration may however be followed (1) with the aid of an external indicator as in IP 104/45(T), (2) potentiometrically with a glass reference electrode and silver sulphide indicating electrode, or (3) amperometrically with a revolving platinum electrode.

(1) The quantitative standard method involves the addition of ferric alum solution followed by titration with ammonium thiocyanate solution to determine the excess silver nitrate. Hydrogen sulphide if present must be removed prior to the determination by shaking the sample with slightly acidified cadmium acetate solution.

(2) The potentiometric method[7,8] depends on (a) the insolubility of silver mercaptides and silver sulphide in alkaline solution and the relatively greater insolubility of silver sulphide, (b) the interaction of elemental sulphur with excess mercaptan in alkaline solutions and (c) the potentiometric determination of the points at which all the sulphide ions and all the mercaptide ions have been precipitated by standard silver nitrate solutions. Completion of the titration with this solution is determined by measuring the change of potential of a silver/silver-sulphide electrode ; a mercury half-cell or in a later modification a glass electrode, serving as a reference electrode. The changes in the potential of the silver/silver-sulphide electrode are a measure of the relative changes in silver ion concentration during the titration.

To make a determination, the glass reference electrode, sulphide-coated silver electrode and a mechanical

stirrer are immersed in the electrolyte and the electrode leads are connected to an electronic voltmeter. A record is made of the initial E.M.F. between the electrodes and measured increments of standard silver nitrate solution are added at intervals allowing sufficient time between each addition to establish an unchanging potential. A plot is made with E.M.F. readings as ordinates and a quantity of silver nitrate added as abscissae, the end-point of the titration being taken at the most positive value of the steep portion of the curve. With mercaptan alone, in the absence of hydrogen sulphide and elemental sulphur, the end-point occurs at +0.200 volt. Should hydrogen sulphide and mercaptan occur together in the absence of elemental sulphur two "breaks" will occur in the curve, the first at about −0.4 volt due to hydrogen sulphide and the second at or below 0.20 volt for mercaptan.

(3) Mercaptan sulphur has also been determined amperometrically[9] by titration with silver nitrate solution utilizing a rotating platinum electrode. The rotating electrode is placed in the solution to be titrated, electrolytic connexion is made with the reference electrode and the current which flows through during the titration is read on a microammeter. The diffusion current of the silver nitrate reagent is measured at the potential of the rotating electrode. When current readings during the titration are plotted against the volume of reagent added, two straight lines are obtained which intersect at the end-point, from which the mercaptan-sulphur content may be calculated.

Elemental Sulphur

The procedure generally adopted by both the American and British petroleum industries for the detection of elemental (or corrosive) sulphur is the copper strip corrosion test (IP 64/51). Types of compound also said to cause corrosion are hydrogen sulphide and polysulphides but mercaptans, thiophenes, sulphides, and disulphides are believed to be non-corrosive provided high temperatures are avoided. The temperature and time of exposure exert considerable influence on the test.

Modifications of the test differ in detail but in general the procedure is to immerse a clean strip of mechanically polished pure sheet copper in the oil under test. The tube containing the sample and strip is heated at a fixed temperature and period of time. At the expiration of this period, the strip is examined and the presence of sulphur or corrosive sulphur compounds is indicated by corrosion or discoloration of the strip. The method is qualitative but recently several new proposals have been advanced to place the test upon a quantitative basis.

A standard method for this purpose consists in dissolving the sulphided copper in an acid bromine solution followed by estimation of the sulphate ion by means of barium chloride solution.

A. Bolt[10] has given a summary of work carried out to develop corrosion standards and a set of copper strip standards has been evolved, each strip having allocated to it a corrosion number (1-12) and an appropriate descriptive term. The used copper strip is compared with the standards and the number and description of the standard which most nearly matches the strip is recorded.

B. Claxton and French[11] have devised a method for the quantitative evaluation of copper strip corrosion based upon conversion of the sulphide on the strip to hydrogen sulphide by treatment with hydrochloric acid, followed by comparison with standards of the amount of stain produced by the hydrogen sulphide upon lead acetate paper. The apparatus consists of a flow meter for hydrogen connected to the test tube containing the copper strip. A small tap funnel is fitted into a bung in the top of

the test tube together with inlet and exit tubes for the hydrogen. To the outlet tube of the test tube a holder for the lead acetate paper is fitted. After assembly of the apparatus, 20 ml of hydrochloric acid is placed in the separating funnel, the copper strip in the test tube and a lead acetate paper strip in the holder or at the end of the train. Hydrogen is streamed through the apparatus for about 10 min, at the end of which period the paper should show no stain. Acid is then run into the test tube whereby the sulphide stain on the copper strip is converted to hydrogen sulphide which on coming into contact with the lead acetate paper stains it greyish-brown to black. The lead acetate paper is then removed and the stain thereon compared in a Lovibond comparator with standard stains representing known amounts of free or corrosive sulphur.

C. Matthews and Parsons[12] have put forward a cathodic-reduction method in which the copper strip is made the cathode of an electrolytic cell which contains sodium hydroxide solution, the anode being of clean copper. A small current is applied and the variation of potential across the electrodes with time is measured. The current (a few milliamperes) remains sensibly constant throughout the test, inasmuch as the potential changes produced during reduction are small compared with the total potential across the electrodes.

A step-wise graph is then obtained by plotting potential against time. The nature of the film, e.g. cuprous or cupric sulphide or oxide may be deduced from the potential; whereas the corresponding time interval indicates the amount of the compound present.

By applying the formula $S = (At)$ (C.1662) where

S = Sulphur in micrograms
A = effective current in milliamperes
t = sum of the reduction time, in seconds, for cuprous and cupric sulphides

the sulphur content of the film may be calculated.

D. For the direct determination of elemental sulphur the method of Davies and Armstrong described earlier may be used. The interaction of elemental sulphur with mercaptans in alkaline alcoholic solutions forms the basis of this determination. It has been found that the predominant reaction in the oxidation of sodium mercaptide by elemental sulphur is the formation of mixed sodium alkyl disulphide which reacts with the silver ion to yield finally silver sulphide and alkyltrisulphide:—

$$A + RSNa \rightleftharpoons NaSSR$$

$$2NaSSR + Ag^{+} \rightleftharpoons Ag_2S + R_2S_3$$

Should the sample contain insufficient mercaptan to react with the sulphur, a measured amount of mercaptan is added. Hydrogen sulphide if present must be removed by washing with a slightly acid solution of cadmium acetate.

E. A polarographic method for the determination of free sulphur has been described recently and is said to be accurate to $\pm$ 2 p.p.m. in the range of 1-100 p.p.m. The method is based upon the diffusion current produced when elemental sulphur is reduced at the dropping mercury electrode, a saturated calomel half-cell being used as the reference electrode. An inert gas previously saturated with methanol is bubbled through the solution before the determination to remove dissolved oxygen which would otherwise affect the result. The determination is completed by comparing the plot of the diffusion current with curves representing known amounts of free sulphur.

Thiophene

The isatin and alloxan methods are in general use for the determination of thiophene and in both cases the method is to shake a suitable volume of the sample with a concentrated sulphuric acid solution containing 0.01 per cent W/V of the reagent. The colours pro-

duced are compared with standards or are measured and the concentration of thiophene obtained from a previously prepared calibration curve. The isatin method is slightly more sensitive than the alloxan and is capable of detecting 0.00005 per cent on a 5 ml sample.

Carbon Disulphide

Either the xanthate or the diethyldithiocarbamate methods are used for the determination of carbon disulphide.

A. For the xanthate method a portion of the sample is treated with alcoholic potassium hydroxide, the resulting potassium xanthate, together with the excess of potassium hydroxide, being extracted by water washing. The extract is acidified with acetic acid and titrated with standard iodine solution, using starch solution as indicator in the usual manner.

B. For the diethyldithiocarbamate determination, an appropriate quantity of sample containing 0.0004 to 0.00012 g of sulphur as determined by a preliminary test is pipetted into a cylinder provided with a ground glass stopper. One ml of diethylamine and 1 ml of a 0.03 per cent solution of copper acetate in alcohol are added. The mixture is made up to 25 ml with carbon disulphide-free benzene and shaken. After standing a few minutes the mixture is transferred to a Nessler cylinder and the golden brown colour matched against standards.

REFERENCES

(1) Javes, A. R. *J. Inst. Petrol*, 1945, **31**, 129-53.

(2) Mapstone, G. E. *J. Inst. Petrol.*, 1948, **34**, 486-9.

(3) Hindin, S. G., and Grosse, A. V. *Anal. Chem.*, 1948, **20**, 1050-2.

(4) Hagerman, D. B. *Anal. Chem.*, 1947, **19**, 381-3.

(5) Wilson, H. N., and Straw, H. T. *J. Soc. Chem. Ind.*, 1950, **69**, 79-82.

(6) Zermany, P. D., *et al. Anal. Chem.*, 1949, **21**, 493-7.

(7) Davies, E. R. H., and Armstrong, J. W. *J. Inst. Petrol.*, 1943, **29**, 323-8.

(8) Tamele, M. W., and Ryland, L. B., *Industr. Engng Chem. Anal.*, 1936, **8**, 16.

(9) Kolthoff, I. M., and Harris, W. E. *Industr. Engng Chem. Anal.*, 1946, **18**, 161-2.

(10) Bolt, J. A., *Oil Gas J.*, 9.8.47., **46** (14), 99.

(11) Claxton, G., and French, K. H. V. *J. Inst. Petrol.*, 1949, **35**, 496-507.

(12) Matthews & Parsons, *Paper presented to API.*, May 1950.

★ ★ ★

ANOTHER DEEP TEST WELL FOR ASSAM

A deep test of oil possibilities in the Brahmaputra Valley, Assam, India, is to begin, the Assam Oil Company Ltd. has announced in Digboi.

The location for the well is close to the Assam Railway about 1¾ miles north of Nahorkatiya Station, 13 miles south of Tinsukia, in the north-east corner of the State.

The latest type of deep drilling equipment will be used and it is planned to go to 15,000 ft if necessary.

The drilling of this test is the outcome of intensive exploration throughout 8000 square miles of the Brahmaputra Valley and the adjoining hills.

In the valley itself the possible oil-bearing rocks are concealed by alluvial deposits and gravimeter and seismic surveys have been made over the area. These surveys have suggested the site chosen for a test well.

The Assam Oil Company has another test well drilling at Nichuguard, about 10 miles from Dimapur, in the Naga Hills of Assam. Test wells recently drilled by the company at Tiru Hills and Barsilla, also in Assam, failed to find oil.

★ ★ ★

Industrial Safety Conference. It is regretted that in the December 1951 issue, on page 444, the date of this Conference was given as 1947 instead of 1951.

TRAINING PETROL SALESMEN

The coming into operation of "100 per cent service stations," garages which sell only one company's petrol, has focused attention on the improvement of the service station. Schemes are in operation by which the lay-out and decoration of a service-station are modernized by architects of the company which supplies the petrol and there are also training schemes for forecourt salesmen.

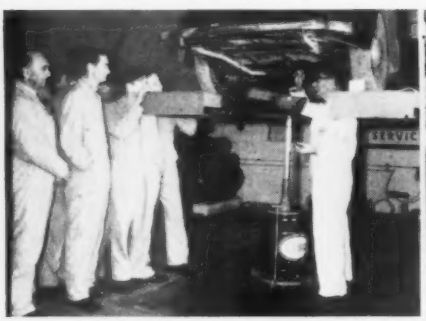
Esso House, Abingdon, is now running courses of a week's duration, during which groups of garage and service station employees are shown, both in lecture room and by practical demonstrations, how to become first-class forecourt salsmen. Esso's aim is that each course shall include representatives from different parts of the country, both young and older people, men and women, even husbands and wives.

Recently, at the first press conference to be held at Esso House, Abingdon, an opportunity was given to see training in progress and the facilities available for trainees, who after the day's work is over have the excellent staff amenities of Abingdon at their disposal.

In the model forecourt men and girls demonstrated the "five-point plan" of service, which starts with a cheerful greeting from the salesman to customer, and the cleaning of the driver's side of the windscreen, before getting down to the business of filling up with petrol, etc. Inside the filling station is a waiting room for customers, where gadgets are temptingly displayed sixpenny store fashion, so as to stimulate sales.

In the classroom, trainees sit at horseshoe tables, and lively discussions and exchanges of hints and tips take place. Opinions are aired on such topics as the use of paper covers to protect from dirt the car's seat and steering wheel when it is being handled by a garage employee. These covers, most students thought, are much appreciated by women drivers.

During the press visit, a conference was held with E. W. Hardiman, manager of advertising and sales promotion, Esso Petroleum Co. Ltd. in the chair, at which questions were also answered by R. J. Pinder, general sales manager, and A. Waterson, marketing director. Mr Pinder said that so far out of 26,000 petrol stations in the country, 20,000 were taking 100 per cent service from one or other of the large suppliers of petrol. Among the advantages to the public were that economies made by reduction in distribution costs—an average load for a garage was now around 800 gallons—must eventually lead to a more economic price structure.



The making of a forecourt salesman (or saleswoman). Practical instruction in the lubrication bay (left) and (right), the "five point" plan of forecourt service is demonstrated at Esso House, Abingdon.

OIL'S CONTRIBUTION TO THE U.K. FUEL ECONOMY

Properly used, oil fuel can and does make a most important contribution not only to Britain's available fuel supply, but to the country's industry, said Mr H. Cunliffe, Fuel Oil Manager, Shell-Mex and B.P. Ltd., in a recent presidential address to the Fuel Luncheon Club. He appreciated that while fuel oil was a major product in the petroleum industry, it provided only a small part of the fuel requirements of the U.K.—during 1950 it provided a little over 2½ per cent of the total fuel of all kinds used for inland purposes in the country. None the less its contribution was greatly in excess of that indicated by quantities or simple percentages.

Speaking of current consumption and future supply of fuel oil, Mr Cunliffe said "Oil fuel for inland use during 1951 is expected to show a marked increase over last year and to reach six million tons. If bunker deliveries are added the total is likely to be above 9½ million tons. In the past a lot of this oil was imported in the form of finished products, but the refinery programme, now very well advanced, has established a new and great British industry which in the course of 1953 will reach a capacity for processing a total of 26 million tons of crude oil, of which some 11 to 12 million tons may be expected in the form of fuel oils. Not all of this will be available for the inland market, as bunker requirements will still have to be met and some oil may be required for export, but it does seem likely that the completion of the refinery programmes will assure sufficient supplies for good oil fuel outlets, subject, of course, to conditions permitting its profitable disposal."

Turning to proper uses of oil, Mr Cunliffe submitted that any proposal for its use can be judged simply on the answers to three questions:

1. Will more and better goods be produced by using oil instead of coal?
2. Will fewer B.Th.U's per unit of output be used than with coal?
3. Will operating conditions be improved and labour requirements be reduced?

If the answer to these three questions is "yes," then the application will certainly be a good case for oil and the industry concerned will benefit by its use.

Taking some specific industries, Mr Cunliffe first dealt with one of the basic industries, i.e. steel making, in which he found the answers to all three questions to be "yes." First, results indicate that 10 to 15 per cent more output can be obtained from an oil-fired furnace than from present producer gas furnaces. Secondly, fewer B.Th.U's will be used, for whereas 7 million B.Th.U's are put into the producers for every ton of ingots produced, only 4½ to 5 million B.Th.U's of oil are put into the open hearth furnace. Each ton of oil does the work of 2 and sometimes 2½ tons of coal. Thirdly, there is no doubt that labour can be materially reduced.

Mr Cunliffe put forward similar evidence on behalf of the use of oil in the pottery industry: in the drying of hops, malt, grain and grass, all of which need a fuel which is clean and easily controllable, and in the general metallurgical industry in which oil has been used for over 30 years for such diverse jobs as metal melting, drop forging, bolt and nut making, tube welding and so on.

Another field in which oil fuel can confer both technical and economic benefits was that of power. The diesel engine, Mr Cunliffe considered, is still the most efficient prime mover and its extended use could make a very valuable contribution to Britain's fuel

economy. One application of power was that of rail traction. The diesel engine is established for shunting locomotives and widely accepted for such use both on British Railways and for private works haulage. But if the diesel or diesel-electric engine were also adopted for main line work in Britain "it is probable that the 15 million tons of coal that is consumed every year in steam locomotives could be replaced by about 3 million tons of diesel fuel. This would not only make coal available for other uses and for export, but would bring about improved living conditions for railway personnel."

The larger stationary diesel engine should also be considered, especially if regarded as a source of both power and heat.

Besides the clearly-defined field in which the use of oil undoubtedly helps by increasing production, improving quality and saving B.Th.U's, there is a secondary field in which the amenity value of oil is the predominating factor in its use. As examples Mr Cunliffe cited bakeries, food factories, breweries, and space heating in hospitals and schools.

Concluding, he emphasized that Britain's industrial efficiency depends as much on the efficient use of oil in its proper spheres as on the efficient use of coal and its derivatives in theirs; the two sources of energy are complementary to, and not competitive with, each other.

★ ★ ★

MOTOR INDUSTRY RESEARCH ASSOCIATION

Report of MIRA for the year ended June 30, 1951, indicates that further work on spray atomization with swirl atomizers shows that the tangential component of velocity has a relatively great importance in giving finer atomization. It is suggested that the tangential component causes a stretching of the jet circumference while the fluid motion in the orifice of a swirl atomizer produces violent turbulence.

Viscosity is the property which most determines the degree of atomization, but its influence is indirect. Surface tension has little effect on atomization from a centrifugal atomizer.

High Speed Engine Lubricants

Service tests were completed on the high speed C.I. engine lubricants previously tested in the laboratory. On a "go" and "not go" basis two plain oils failed and all six additive oils passed when low sulphur (0.2 per cent) fuels were used. With the high sulphur (2 per cent) fuels, two plain and one additive oils failed and five additive oils passed.

Under the auspices of the IP the same oils have been tested by the CRC L-I-545 (Caterpillar) method. Using low sulphur fuels, the same distinctions were shown.

Further work is in progress.

Oil Consumption

Lack of reproducibility still hampers the work on the effect of piston assembly on oil consumption and blow-by. Although no conclusive results have been obtained, the information obtained is of interest. The tests are being continued but the work may have to be abandoned.

★ ★ ★

COMPANY PRODUCTION—CRUDE OIL, 1951

	Oct.	Nov.
	Tons	
Kuwait Oil Co.	2,980,467	2,873,895
		Dec.
		Brl.
Trinidad Petroleum Development Co. ...		257,732
British Controlled Oilfields:		
Venezuela:		
Western Area		12,059
Central Area		17,522
Kern Oil Co.:		
California		116,191
Trinidad		72,041

AROUND THE BRANCHES

Fawley Branch

On December 12, 1951, a meeting of the Fawley Branch was held at the Esso Recreation Club, Holbury, with Dr F. Mayo in the chair,

P. A. Matthews (Messrs Stewart and Lloyds Ltd.), opened his address on the production of piping and tubing by saying that he did not propose to delve into the history of piping. He could, of course, talk about the use of bamboo for the carrying of water but, in actual fact, very little was known regarding ancient practices.

He pointed out in his preamble that there were four basic factors which had to be considered in the manufacture of pipe and tubing, and it was these which determined the method of manufacture used. These factors were cost, quality, size, and size tolerance. Mr Matthews then described the various processes which are used, and detailed the various manufacturing methods under the two main headings of welded and seamless pipe. He indicated the diverse uses to which the different qualities of pipe were applied. He then described in detail the methods of manufacture, and this part of his talk was illustrated by slide and film. The butt welding process was used for the manufacture of low duty piping of small diameters, in which the pipe was made from metal strip; the lap welding process for large diameters using rolled plate, and finally the methods used for making seamless tubing for the more critical services. This part of his lecture was of special interest in that it involved some very ingenious operations, particularly the use of the Mannesman piercer. This novel piece of equipment induces shear at the centre of an ingot while passing through specially designed rollers, and so creates a hole in the metal which is opened up centrally by the piercer. The open blooms so made can then be reduced to standard pipe sizes either in the automatic or Pilger mill. He also described the older closed bottle process of piercing, in which the hole is made by driving a mandrel into an ingot held in a closed-ended container.

Mr Matthews closed his address by inviting questions from the audience, who showed great interest by the very large number of queries which were put to the lecturer, particularly by the engineers in the audience. The lecturer was asked in particular of his experience in bending and threading pipe, in view of certain difficulties which had been encountered at Fawley in these operations.

The meeting closed with a hearty vote of thanks to the lecturer, which was proposed by E. Asquith.

London Branch

For its last meeting of 1951 on December 17 at Manson House, the Branch had a joint paper entitled "Oil on the Screen" by Alan W. Deller, vice chairman of the branch, and manager of the Shell Film Unit, and Denis Segaller, one of the Unit's film directors. N. E. F. Hitchcock was in the Chair.

Mr Deller presented the paper which was illustrated by extracts from a number of films. The oil industry offers a vast field for film making within which the industry has concentrated on the documentary type of film with a public relations approach. Many problems arise from dealing with the various activities of the industry and with the impact of oil on the life of the community. The paper briefly examined a number of these problems and illustrated their treatment in petroleum films. The first example was a purely informative documentary covering the origins of petroleum—the Anglo-Iranian colour cartoon film *As Old as the Hills*. Drilling and production have not yet been tackled very extensively but drilling offers opportunities for

interesting and often dramatic treatment as was seen in *Louisiana Story* (shown to the Branch in May, 1951) and an extract from *Harvest for Tomorrow* which showed actual drilling sequences.

When portraying characteristics and uses of products it is difficult to produce, in a visually interesting form, a summary of all the important scientific properties. In the case of products such as bitumen the facts are relatively simple as was shown in an extract from the film *Asphaltic Bitumen* which showed actual samples being handled and tested in the laboratory and in service. In the case of other materials, abstract conceptions have to be turned into visual images and an extract from *Octane Number* demonstrated the use of animated diagrams to bring an abstract technical concept into clearer focus for the layman. The difficulty of illustrating refining processes is the masking of action inside pipes and vessels. Extracts from *Cracking* and *Components for Aviation Gasoline* showed how complicated was diagram work combined with background scenes from actuality.

Having shown some of the results, the authors took us behind the screen. The film director sorts out his subject in film terms and decides where to use actuality shooting and where animated diagram. Thereafter he consults the animation artist who by patient and concentrated work brings an idea to life on the screen; some of the complications involved were described.

In the discussion that followed the use of incidental music in technical films was debated at some length and questions were asked on the audience level to which petroleum films were aimed, the value of colour, and particular aspects of a director's work.

W. D. Davies, proposing a vote of thanks to the authors, introduced many amusing allusions to the evenings entertainment. The vote was carried with acclamation. A considerable number of members joined together to greet the festive season after the meeting, the authors being the guests of the Branch at the customary informal dinner.

Northern Branch

The Northern Branch has been very active recently, a diverse programme of meetings and social events having been well supported by members. On November 23, the annual dinner and dance held at the Midland Hotel, Manchester was attended by over 120 members and guests. The Branch was again honoured by the presence of the Deputy Lord Mayor of Manchester, Col. S. P. Dawson, who proposed the toast of the Institute. In his reply, Mr E. A. Evans, a past-President of the Institute, commented lightly and wittily on the services rendered to the ladies by petroleum, especially its associated chemical branch. In proposing the toast to the guests, Mr H. H. Ballard, Chairman of the Branch, welcomed particularly those members of associated industries which had contributed so much to the post-war expansion of refining capacity. An outstanding example was the Manchester Ship Canal Co. which had done so much for the north-west, whose Chairman, Mr Leslie Roberts, they were very glad to have present. Mr Roberts replying for the guests, claimed brevity as the soul of pre-dance wit and the party shortly afterwards adjourned for dancing. This continued until a late hour when the evening was informally terminated by the Chairman, members, and guests joining in the traditional farewell song.

The December meeting continued the social atmosphere set by the annual dinner and the Christmas season and nearly 70 members met in the Warner private theatre for a programme of films about the industry and its products. Several of these, in particular those on atomization of fuels and the manufacture of grease, seemed very suitable for

Northern Branch Dinner Dance. Institute members at the top table included (left to right) T. W. Ranson, E. J. Dunstan, E. A. Evans and H. H. Ballard (Branch Chairman). Colonel S. P. Dawson, Deputy Lord Mayor of Manchester, is on the extreme right.

instructional use as well as entertainment and several inquiries were made of Mr F. Green who had arranged the programme through Shell-Mex & B.P. Ltd. After half-an-hour of vicarious thrills watching the film of the 1950 Isle of Man T.T. Races, members adjourned to the Engineers' Club where a buffet supper in the true Lancashire manner was enjoyed. Speeches were out of order, but a vote of thanks to the honorary secretary, Mr G. W. Davies, for his efforts in organizing such a successful addition to the season's syllabus was proposed by the Chairman and enthusiastically carried.

Stanlow Branch

A joint meeting of the Stanlow Branch with the Liverpool and North West Section of the Royal Institute of Chemistry was held on December 19 when a talk on the Scottish Shale oil industry was given by Dr G. H. Smith. The lecturer described mining methods, which are similar to those of the coal industry. Shale production is at present carried out in Scotland from 11 mines and 2 open cast workings. Retorting is by modern Westwood method which is thermally self-supporting owing to introduction of air and almost complete combustion of carbon in the shale. The older retorts still in use at Pumpherston and Broxburn are not self-supporting. Refining processes for shale motor spirit (both straight-run and cracked), diesel fuels, and wax were described, and some account was given of hydrocarbon analyses of the lighter fractions. It is necessary to carefully control pressable wax cuts with respect to final boiling point, otherwise trouble can arise in the cold-pressing stage. In 1941 the sweaters were changed to the vertical tube type with much improvement in operating results.

The following by-product processes were also described:—

(1) Ammonium sulphate using ammonia produced during retorting and spent acid from treating processes. Product of 99.5 per cent purity is obtained.

(2) Detergents.

(3) Bricks made by using 8 per cent lime with weathered spent shale and autoclaving in steam chambers, no firing being used. About 60,000 bricks a day are processed, but accounts only for a small proportion of the spent shale.

The profitability of the entire process (25 gallons of oil per ton of shale) is assisted by tax rebate on motor spirit and diesel fuel.

A vigorous discussion ensued, at the close of which a vote of thanks was proposed by A. J. Ham.

TRINIDAD PETROLEUM INDUSTRY IN 1950

Reporting for the year 1950 on the Trinidad petroleum industry* W. N. Foster, the Petroleum Technologist, states that "In spite of the incentive to find and produce more oil...the industry was only just able to maintain production at the level of the previous year." He also mentions that the overall effect of maintaining production and of increasing exploration in face of the inflationary trend has been to reduce the cash resources of the eight British oil companies working in Trinidad by $6½ million during the past three years in spite of dividend restriction and additional working capital.

Drilling and Exploration

During 1950 25 rigs were in continuous operation, 18 being steam rigs on exploitation or semi-exploration work, and 7 modern heavy diesel outfits on wildcatting operations. Total depth drilled was 659,565 ft.

The previous depth record was twice passed—by Trinidad Leaseholds at Morne Diablo 34 location (12,604 ft) and by Trinidad Petroleum Development at Coora 188 (13,471 ft).

The number of wells completed during the year was 144, of which 136 were producers. Average depth of completed wells was 4436 ft.

Of 38 wells with objectives greater than 8000 ft commenced during the period 1945-9, 18 have been abandoned as dry holes, 9 encountered oil sands not sufficiently productive to pay for the cost of drilling, and 11 were commercial producers. Fifteen new deep wells were commenced in 1950, of which 3 have been abandoned, 8 have little prospect of commercial success, and 4 are producers.

*"Administration report of the Petroleum Department for the year 1950," Trinidad Government Printing Office, 1951, 72 cents.

Oil Production

Total production of crude oil in 1950 was 20,632,421 brl, a daily average of 25.7 brl/day per producing well compared with 27 brl/day in 1949. Of the average of 2197 producing wells, 594 were flowing and 1603 on artificial lift. Daily average production per flowing well was 50.2 brl and per artificial lift well 16.6 brl.

Refining

Clearing of the site for the new cat cracker at Point-à-Pierre was commenced in 1950.

Crude and process oils run to stills totalled 4,256,487 tons and refining output was:

	Tons
Aviation spirit:	
100 octane	44,197
Other grades	129,955
Motor spirit	569,187
White spirit	338
Burning oil	60,317
Vaporizing oil	163,891
Gas and diesel oils	599,359
Fuel oils	2,359,050
Lubricating oil and grease ...	367
Bitumen	66,361
Other products	37,897
Feed-stock	32,613

Natural Gas

Total production of natural gas was 32,311,651 M.c.f. (1000 cu. ft.), of which 2,674,012 was returned to formation.

The charcoal adsorption plant of Apex Trinidad Oilfields processed an average of 9.62 million cu. ft. per day, the average yield being 1.06 gal natural gasoline per 1000 cu. ft. The oil adsorption plant of T.P.D. had an average throughput of 8.28 million cu. ft. per day at 0.706 gal per 1000 cu. ft.

Asphalt

The extraction from the Pitch Lake totalled 132,846 tons in 1950 and the operating company had been granted a new lease for 30 years from 1 February 1956. Terms, royalty, and duty remain the same being 60 cents royalty and $1.20 export duty per ton of crude pitch exported, and 84 cents royalty and $1.66 duty per ton of dry asphalt content on pitch products.

Contribution to Revenue

During 1950, the petroleum industry contributed $16,875,640 or 30.1 per cent of Trinidad's revenue, and in addition $1,367,860 was collected from the general public as excise on petroleum products.

Other disbursements in the Colony by the industry totalled $18,839,945 in wages, $6,125,164 to contractors, $3,946,065 for materials, $8,456,079 in rents, private royalties, etc., a total of $37,367,253.

The c.i.f. value of imports of materials from overseas totalled $21,831,730, made up of U.K. $14,690,802, United States $5,469,200, Canada $724,216, other countries, $947,512.

★ ★ ★

SERVICING B.O.A.C's JETS

A fleet of 60 new general-purpose airport fuellers are being introduced along the routes to be flown by B.O.A.C's "Comet" jet airliners and other advanced aircraft. The vehicles are named "Dorsets," and they have been designed by Shell in conjunction with Thompson Bros. (Bilston) Ltd. and Leyland Motors Ltd., who manufacture the chassis.

Maximum capacity of each vehicle is 3,000 Imp. gal., and the fuellers are capable of "overwing" fuelling, using two hoses, at not less than 100 gal per min per hose, or alternatively "under wing," or "pressure" fuelling, at 200 gal per min.

ANOTHER LOOK AT FAWLEY

Of interest to the industry in general, as well as to those who attended the memorable official opening of Fawley refinery, are two Esso short films recently shown in London.

"Refinery in Miniature" tells the story of how a complete model of the refinery, 15 ft in length, was made from such materials as plywood, steel wire, cardboard, sand and paint. Bits of old office files, for instance, built Fawley station; wire wool, painted green, made individual trees. This model was first exhibited in connexion with Southampton's Festival of Britain celebrations.

"On Stream," the other film, is not only an interesting pictorial record of the official opening, but gives a peep behind the scenes at the vast preparations which had to be made for the 6,000 guests who attended the ceremony. Workmen are seen unrolling long stretches of carpet; waitresses wash 30,000 plates, 60,000 pieces of cutlery and innumerable glasses; flowering plants are put into the earth, pots and all. And after the opening ceremony, the guests are shown seated at lunch in the marquees—it is said this was the largest party ever to be served with a meal under canvas. Only one guest, apparently too young to participate, is left outside, his (or her) pram being parked in a lonely state outside the marquee.

★ ★ ★

A CELEBRATION

On January 3 members of the Publications Committee and its Papers Sub-Committee lunched together to celebrate the fifth anniversary of the foundation of the *IP Review*. The opportunity was taken to entertain several who had given much assistance in the development of the publication to its present high standard—Mr J. R. G. Carlile, Dr L. Ivanovszky, and Mr E. Thornton—together with the editor and his assistant, Mrs E. Hume, and Mr Noble, the advertising manager.

AIOC Developments

These photographs illustrate Anglo-Iranian Oil Company's developments now proceeding in Great Britain. The picture on the right was taken at the Finnart terminal of the 60-mile pipeline through which crude oil reaches the Grangemouth refinery.

In the picture below work is in progress on the jetty in the River Medway at which tankers will discharge crude oil cargoes for the new Kent refinery.

BRITISH OIL SEARCH

Drilling has stopped at 4,353 ft in the test well being drilled just above high water mark on the dunes near Ainsdale on-Sea, Southport, Lancashire, by the D'Arcy Exploration Company (the Anglo-Iranian Oil Company's prospecting subsidiary).

Though oil has not been struck, the operation has provided very useful geological information which encourages further drilling. A considerable amount of geophysical exploration has been done in the Formby area and every bore hole drilled improves the accuracy with which the geologist can interpret the results.

The Ainsdale well was drilled as part of a plan to find the main reservoir from which has seeped the oil being produced from shallow wells three miles away at Formby. About 8,400 tons of oil have been produced from this shallow field.

The data from the Ainsdale well appear to confirm that the original geophysical interpretation was substantially correct, and the oil indications found in the hole suggest that the programme of oil search is proceeding on the right lines. A location for the next well has already been selected and will probably be drilled very shortly.

U.S. NATURAL GAS INDUSTRY IN 1950

Marketed production of natural gas in the U.S.A. in 1950 was 15.9 per cent higher than in 1949, while the gross quantity placed in underground storage was 229,752 compared with 172,051 million cubic feet in the previous year.

The U.S. Bureau of Mines reports (MMS 2027) that total consumption increased by 16 per cent, while total value at the well of the marketed production was $408,776,000 or 6.5 cents per 1000 cu. ft. (6.3 cents in 1949). Value at point of consumption of all natural gas was $1,597,930,000 or 26.5 cents per 1000 cu. ft.

Details extracted from this report are:

	1950	1949
	Million cu. ft.	
Production		
from gas wells	5,603,200	4,986,126
from oil wells	2,876,450	2,560,699
Total	8,479,650	7,546,825
Disposition:		
Marketed	6,282,060	5,419,736
Repressuring	1,396,546	1,273,205
Vented and wasted	801,044	853,884
Consumption:		
Residential	1,198,369	992,544
Commercial	387,838	347,818
Field (drilling, pumping, etc.)	1,187,473	1,059,628
Fuel at petroleum refineries	455,096	422,357
Other, including electric utility plants	2,797,628	2,373,137
	6,026,404	5,195,484

Domestic consumers numbered 16,906,000 and commercial consumers 1347 in 1950, compared with 14,690 and 1231 respectively in 1949. Mixed natural and manufactured gases were used in 1950 by 3,576,000 domestic and 218,000 commercial consumers.

E. C. Masterson (Kuwait Oil Co. Ltd.) (right) and D. A. Hough (general secretary, Institute of Petroleum) inspecting models illustrating the work of Matthew Hall & Co. Ltd. at the company's annual party and exhibition at the Dorchester Hotel in December.

GERMAN CHEMICAL BOOKS

In 1946 the Chemical Council published *German books on chemical and cognate subjects* 1939-46, which rapidly went out of print, so great was the demand. This book has now been completely revised and brought up to date to cover 1939-50 by A. F. Cummins and S. Vince.

The new edition is also a complete re-arrangement of the former edition. The titles are set out under subject headings and an author index is provided. Included are the titles of numerous books known to be in preparation, many of which have since appeared. The book occupies over 100 pages and can be obtained free to those interested, on application to Messrs Lange, Maxwell & Springer Ltd., 41-5 Neal Street, London, W.C.2.

★ ★ ★

THE C.I.E. COLOUR SYSTEM

Recently issued by the Tintometer Ltd. is a 34-page booklet on the C.I.E. international colour system. The author is G. J. Chamberlin and the system is explained in simple terms for the benefit of the non-technical reader. Price is 5s and copies can be obtained from the publishers at The Colour Laboratory, Salisbury.

U.K. PETROLEUM CONSUMPTION AND SUPPLIES

Considerable detail as to the consumption and supply of petroleum products in the United Kingdom is given in the "Ministry of Fuel and Power Statistical Digest 1950" just issued.* Its 217 quarto pages contain a wealth of detail of the U.K. sources of all kinds of fuel and power and in most cases the petroleum tables go back to 1938, and in some cases to 1920. Space limits the extracts given here to the last three years —1948 to 1950—covered by the report.

Tables I and II relate to the quantities of petroleum products delivered for inland consumption. From Table I it is noted that there has been an all-round increase in consumption in the period, the 1950 figure being 10.4 per cent higher than the 1949 total, which was 8.3 per cent higher than 1948.

In Table II further details are given in regard to the purposes for which gas/diesel and fuel oils were used in the three years.

At present the major source of the United Kingdom's refined petroleum requirements are furnished by imports, although increasing quantities are being made available from the home refining of imported crude and process oils. This is illustrated by Tables III and IV, the former showing that imports of petroleum products were 24.8 per cent lower in 1950 than in 1948. On the other hand, as shown in Table IV, refinery throughput and output more than doubled in the same period. Details regarding the total available supplies of crude oils are given in Table V.

It is interesting to record also that in the three year period there has been a considerable increase in the export of petroleum products, as shown in Table VI.

The effect of world conditions and in part of the devaluation of the pound sterling in 1950 on the prices paid for imported petroleum is shown in Table VII. In the aggregate there was a decrease of 1.9 per cent in 1949 as compared with 1948, but in 1950 there was an increase of 30.3 per cent over the 1940 figure.

In Table VIII information is given regarding the quantities of petroleum produced overseas by British and Anglo-Dutch companies.

Some information is also given regarding benzole and coal tar products, and this is set out in Table IX.

TABLE I

U.K. DELIVERIES OF PETROLEUM PRODUCTS FOR INLAND CONSUMPTION

	1948	1949	1950
	Thousand tons		
Aviation spirit ...	273	288	282
Motor spirit ...	4,265	4,671	5,195
Industrial spirit ...	66	65	81
White spirit	142	148	149
Kerosine	1,439	1,525	1,539
Gas-diesel oils:			
For road vehicles ...	817	924	1,034
Gas works ...	470	510	539
other inland ...	898	978	1,056
TOTAL	2,185	2,412	2,629
Fuel oil:			
Refinery fuel* ...	422	499	650
other inland ...	2,742	2,795	3,092
TOTAL	3,164	3,294	3,742
Lubricating oils† ...	660	714	749
Bitumen	493	545	621
Paraffin wax	43	40	43
Miscellaneous‡ ...	43	135	246
TOTAL	12,773	13,837	15,276

*Includes small quantities of other products.

†Includes gas-diesel and fuel oils used in grease manufacture, and small quantities subsequently exported.

‡ Butane, propane, and other gases, and feedstock for chemical plants.

*H.M.S.O., price 15s. net.

Table II

U.K. Inland Deliveries of Gas-diesel and Fuel Oils

	1948	1949	1950
	Thousand tons		
Burning:			
Central heating ...	254	292	365
Bakeries	61	63	64
Glass	206	192	197
Steel manufacture ...	802	794	885
Industrial furnaces	331	349	389
Steam raising, etc	980	955	982
Power:			
Agriculture ...	37	49	55
Marine	251	322	430
Rail traction ...	58	28	22
Stationary engines	264	280	292
Mobile diesel engines	168	195	219
Manufacture:			
Gas	470	510	539
Other manufacture	48	56	59
Other consumption ...	602	697	839
Total	4,532	4,782	5,337

Table III

U.K. Imports of Petroleum Products

	1948	1949	1950
	Thousand tons		
Aviation and motor spirits ...	3,941.3	4,470.5	4,070.2
Other spirits ...	105.0	108.6	107.5
Kerosine ...	1,487.2	1,582.9	1,415.4
Gas oil ...	1,811.2	1,741.0	1,405.1
Fuel and diesel oils	5,507.0	3,289.2	2,436.7
Lubricating oils	354.1	298.1	492.0
Paraffin wax ...	36.0	18.1	33.4
Other sorts* ...	0.3	0.5	3.8
Total ...	13,242.1	11,508.9	9,964.1

*Excludes bitumen and petroleum coke.

Table IV

U.K. Petroleum Refinery Operations

	1948	1949	1950
Throughput:		*Thousand tons*	
Imported crude and process oils	4,408.0	6,170.0	9,201.0
Indigenous crude	39.4	47.8	45.9
Shale oil ...	109.9	112.3	112.9
Total ...	4,557.3	6,330.1	9,359.8
Production:			
Aviation and Motor spirits ...	620.2	904.1	1,487.8
Other spirits	94.8	107.9	106.4
Kerosine ...	121.4	130.5	161.1
Gas-diesel oils	887.8	1,206.9	1,891.1
Fuel oil ...	1,359.4	2,347.6	3,805.0
Lubricating oils	368.0	376.9	427.0
Bitumen ...	532.4	561.9	636.0
Refinery fuel*	401.3	493.5	562.7
Miscellaneous, losses, and other stock changes	172.0	200.8	282.7
Total ...	4,557.3	6,330.1	9,359.8

*Mainly fuel oil and refinery gases. Includes only products used in same refinery.

Table V

U.K. Total Supplies of Crude Oils

	1948	1949	1950
	Thousand tons		
Imported crude and process oils	4,640.6	6,063.7	9,322.8
Indigenous production:			
Crude petroleum	43.6	45.6	45.7
Shale oil ...	109.6	112.5	111.6
Total ...	4,793.8	6,221.8	9,480.1

Table VI

U.K. Petroleum Exports, Re-exports, and Bunkers

	1948	1949	1950
	Thousand tons		
Aviation and motor spirits ...	63.3	99.0	138.0
Other spirit ...	2.5	5.0	12.0
Kerosine ...	9.7	30.0	41.0
Gas oil ...	26.0	52.0	86.0
Fuel and diesel oils	115.3	181.0	774.0
Lubricating oils	121.3	129.0	135.0
Paraffin wax ...	2.6	2.0	3.0
Other sorts *...	3.3	3.0	9.0
Total ...	344.0	501.0	1,198.0
Bunkers† ...	1,983.3	2,031.7	2,228.4

*Excludes bitumen and petroleum coke.
†For vessels engaged in foreign trade and for fishing vessels.

Table VII

U.K. Value of Imported Petroleum and Petroleum Products

	1948	1949	1950
	Value in £ per ton		
Crude and process oils ...	6.69	6.63	7.99
Aviation and motor spirits	11.88	11.96	14.61
Other spirit	13.08	12.52	15.69
Kerosine	10.06	9.75	12.18
Gas oil	9.54	8.54	10.81
Fuel and diesel oils ...	6.46	4.99	6.11
Lubricating oils	22.17	17.36	20.73
Paraffin wax	64.21	49.63	65.85
Other sorts	90.25	76.88	116.02
Total	9.53	9.35	12.18

Table VIII

Overseas Production of Crude Petroleum and Products By British and Anglo-Dutch Companies

	1948	1949	1950
	Thousand tons		
Crude production	65,645	72,311	85,919
Refined products:			
Aviation and motor spirits	9,858	11,344	12,908
Other spirits	188	245	288
Kerosine	3,333	3,715	4,210
Gas-diesel oils	10,162	10,743	13,198
Fuel oils	29,245	32,107	36,140
Lubricating oils ...	205	250	460
Bitumen	968	1,142	1,550
Paraffin wax	36	36	59
Refinery fuel	2,763	3,370	3,810
Other products, losses, etc.	4,759	5,448	5,904
Total...	61,517	68,400	78,527

Table IX

U.K. Production of Benzole and Coal Tar Products

	1948	1949	1950
	Million gallons		
Motor benzole	55.0	58.8	55.3
Motor and aviation spirits:			
L.T. carbonization ...	0.9	1.0	1.0
Hydrogenation	32.4	39.2	39.3
	88.3	99.0	95.6
	Thousand tons		
Road tar	742	648	616
Creosote-pitch mixture ...	310	425	580

FORTHCOMING MEETINGS

Air and Vapour Release from Aviation Fuels. L. D. Derry, E. B. Evans, Ph.D., M.Sc., B. A. Faulkner, B.Sc., and E. C. G. Jelfs, B.Sc. (*Esso Development Co. Ltd.*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), February 25.

Alcohol Motor Fuels. 1. Economics. T. C. Owtram, M.B.E., M.C., M.A., (*Shell Petroleum Co.*). **2. Manufacture and Use.** S. J. W. Pleeth, B.Sc., (*Cleveland Petroleum Co*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m*), March 12.

A Comparison of the Fixed-bed, Liquid-phase ("Slurry") and Fluidized-bed Techniques in the Fischer-Tropsch Synthesis. C. C. Hall, M.Sc., Ph.D, D. Gall, M.A., B.Sc., Ph.D., and S. L. Smith, (*Fuel Research Station, D.S.I.R.*). At 26 Portland Place, London W.1, 5.30 p.m. (*tea* 5 *p.m.*), March 26.

Corrosion Problems in Engineering. S. F. Dorey, C.B.E., D.Sc., F.R.S. At 26 Portland Place, London, W.1, 5.30 p.m., (*tea* 5 *p.m.*), April 9.

Fawley Branch

Distribution of Petroleum. C. H. Collins. At Esso Recreation Club, Holbury, 7.30 p.m., March 19.

London Branch

Address by the President. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*) February 20.

Oil. An Agent of Change. P. M. de Veulle. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*) March 19.

Northern Branch

The Fawley Refinery. G. Noble, J.P., B.Sc., At Engineers' Club, Albert Square, Manchester, 6.30 p.m., March 18.

Scottish Branch

Film Show. At Edinburgh, March 6.

South Wales Branch

A General Survey of Liquid Fuel Gas, Its Distribution and Uses. S. Shaw. At Training Centre, Llandarcy, 5.30 p.m., March 6.

Stanlow Branch

Function of a Refining Control Laboratory. D. H. Japes, M.Sc., At Grosvenor Hotel, Chester, 7.30 p.m., March 19.

OTHER SOCIETIES

Power in the Future. Dr J. Bronowski. Joint Meeting, E. Midland Section, Institute of Fuel and Loughborough Scientific Society. At Loughborough College, 7.15 p.m., March 7.

Liquid/Liquid Extraction in Laboratory and Pilot Plant. J. F. Short and P. Eaglesfield. Institution of Chemical Engineers, Midlands Branch. At Latin Theatre, The University, Edmund Street, Birmingham, 3 p.m., March 8.

The Internal Combustion Engine from the User's Point of View. A. K. Bruce. Diesel Engine Users' Assoc. At Caxton Hall, London, S.W.1, 2.30 p.m., March 20.

★ ★ ★

STUDENTS' ANNUAL DINNER

The annual dinner of the Birmingham University Chemical Engineering Society and Student Branch of the IP will be held on March 18 in the Guild of Undergraduates Union. Principal guest will be Sir Ewart Smith, M.A., M.I.Chem.E. Tickets (price 16s) from P. F. Jones, c/o Department of Chemical Engineering, The University, Birmingham, 15.

★ ★ ★

APPOINTMENTS VACANT

CHIEF ENGINEER required for oilfield equipment manufacturers based in England. Must have knowledge modern drilling and production equipment design and operational techniques, with background foreign oilfield service preferably in the Americas. Excellent opportunity to right man for high advancement. Full details, which will be treated in strict confidence, to Box 1065.

MANAGER required for an expanding oil storage installation on the Thames, handling both heavy and light mineral and vegetable oils and also petroleum spirit.

The installation includes a tanker berth, barge berths as well as road and rail access.

Imperative that applicants have had previous experience in charge of similar installation and be familiar with the handling of all types of liquid cargoes. A full knowledge of Customs requirements and formalities essential. Applicants must be able to supervise staff. A pension scheme is in operation. Salary according to qualifications and experience.

Applicants should write fully stating qualifications, age and experience to Box 5567 c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.

Monsanto Chemicals Limited require the services of a **CHEMIST** for a senior position in a group working on application research and technical service problems associated with the use of chemical additives in petroleum products, at laboratories near London. Applicants should possess good academic qualifications, should have had post graduate research experience and, preferably, some experience in the oil industry. The post, which is pensionable, offers good prospects to candidates possessing initiative and vision. Salary will be commensurate with qualifications and experience. Applications, which will be treated in strict confidence, should be sent to The Chief Personnel Officer, Monsanto Chemicals Limited, Allington House, London, S.W.1, and should contain full details of age, experience and qualifications.

THE LIQUID FUEL GAS INDUSTRY COMMITTEE invites applications for the position of General Secretary. Applicants should be 30-45 year of age and must have a good technical background. The office will be in London. Commencing salary according to qualifications, but will not be less than £1250 per annum. Apply with full particulars of qualifications and experience to Box No. 1066.

THREE OR FOUR CONTRACT ENGINEERS required immediately by **KELLOGG INTERNATIONAL CORPORATION, LONDON.** Should have University training with degree, working knowledge of mechanical engineering, physical chemistry, knowledge of metals, and have spent eight to ten years or more in industry. These are new posts and are required for expansion programme for petroleum refinery, and chemical plant design and construction, but applicants considered with good coke oven, gas works or sugar refinery practice. Duties would consist of producing from finished process data and flow sheets, etc., specification of equipment such as large fractionating columns, heat exchangers, calculation of piping, pumps and associated steel structures, instrumentation, etc. Good salaries and future with executive status to really suitable high calibre men with requisite ability and experience. Applications stating details of age, education, experience, in strict confidence to C.W.K. Box 1067, offices of IP REVIEW.

Eliminate "CREEP"
WITH
Marwin
HIGH TEMPERATURE
CREEP RESISTING STUDS
BOLTS, NUTS & SPECIAL PARTS
A positive defence against the effects of heat, these "Marwin" Products resist "creep" at elevated temperatures, resist embrittlement from exposures to high temperature stresses and at the same time retain high tensile strength at elevated temperatures. Write for details.
W. MARTIN WINN LTD
DARLASTON : : S. STAFFS.
Phone: Darlaston 72/3/4. Grams: "Accuracy, Darlaston."

STRUCTURES IN STEEL

We Specialise in

ALL TYPES OF STRUCTURES

required for

Oil Production and Refining.

ALSO

'KELVIN' *all iron* and **'MAINSTEEL' PALISADING**
and **All** Types of **FENCING**
for **HOME** and **OVERSEAS.**

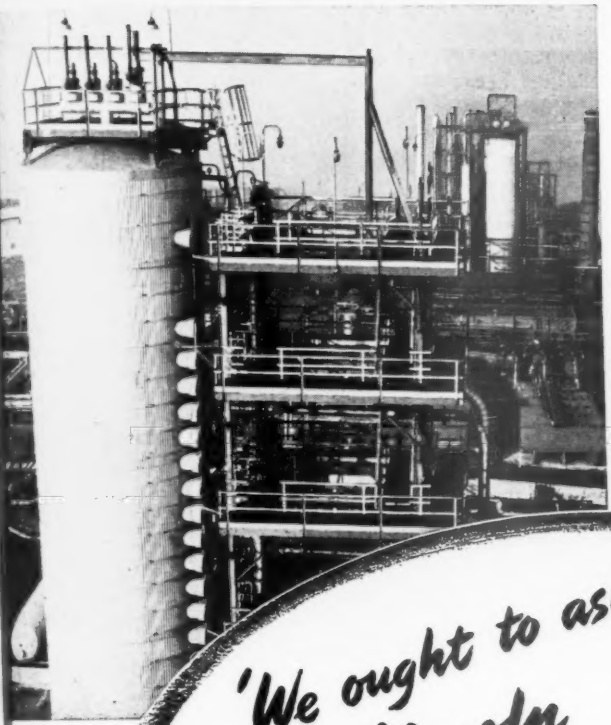
A. & J. MAIN & CO., LIMITED

LONDON: VINCENT HOUSE, VINCENT SQUARE, S.W.1
Telephones: Victoria 8375/6/7/8 *Telegrams:* Kelvin Sowest, London

WORKS AND REGISTERED OFFICE

CLYDESDALE IRONWORKS, POSSILPARK, GLASGOW, C.2
Telephone: Possil 8381 *Telegrams:* Kelvin, Glasgow

CALCUTTA: Post Box 36, 16 NETAJI SUBHAS ROAD
Also Nairobi and Chittagong



Benches A and B Distillation Plant of the National Oil Refineries Limited at Llandarcy, South Wales, where the throughput is 80,000 barrels per day. Lincoln arc-welding again, of course.

'We ought to ask Lincoln before we decide'

LINCOLN

World's largest manufacturers of arc-welding equipment and electrodes

LINCOLN ELECTRIC CO LTD · WELWYN GARDEN CITY · HERTS · WELWYN GARDEN 920

SM 26

Telephone:
Clerkenwell 2908

Telegraphic Address:
"Gasthermo, Barb, London"

The mark of precision and efficiency
BRITISH MADE THROUGHOUT

B. BLACK & SON, LTD.

180 Goswell Road, London, E.C.1

MANUFACTURERS OF LABORATORY THERMOMETERS

Fluid-in-Glass Thermometers graduated on stem, for determining temperatures between — 200/+520 °C. with an accuracy, corrections and permanency well within the limits permissible to obtain N.P.L. Certificates.

The filling in the etchings is heat resisting and is insoluble in all solvents with the exception of those that attack the glass itself.

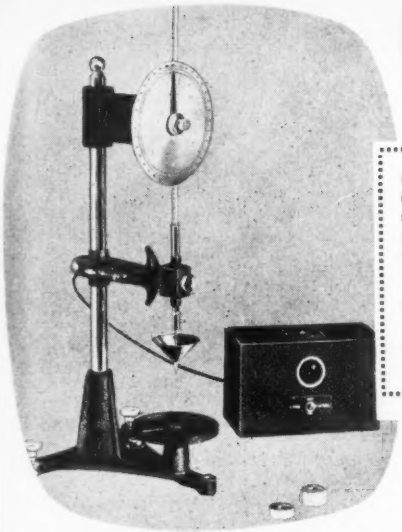
MAKERS OF THERMOMETERS TO ALL SPECIFICATIONS FOR PETROLEUM TESTS

Colour Measurement *and* Colour Grading

★ Lovibond instruments for "on the job" checking as well as for laboratory work

Available from stock

THE TINTOMETER LTD., Salisbury, England



PENETROMETER

with automatic control

Used for penetration tests of bituminous materials, petrolatum and grease to I.P. and A.S.T.M. specifications, this instrument can be operated manually or by means of the automatic control box illustrated on the right. It is available for immediate delivery.

Its six-inch diameter dial graduated in 1/10 mm. to read 40 mm. in one revolution provides quick and accurate readings, whilst the control box ensures extreme accuracy to the 5 second period.

Please write for full details of this instrument and other Petroleum Testing Equipment to :

Petroleum Equipment Sales

W & J GEORGE & BECKER LTD

NIVOC HOUSE

Ealing Road, Alperton, Wembley, Middx.
Telephone: PERivale 3344

157 Great Charles Street, Birmingham, 3
Telephone: CENtral 7641

Laboratory Furnishers. Manufacturers of Scientific Apparatus, Balances and Weights. Suppliers of Chemicals and Analytical Reagents.

P14

NICEROL

FATAL TO FIRES

Here is a foam compound that will kill any oil or petrol fire with speed and certainty. Nicerol is a concentrate, producing a heavy-type foam of closely knit small bubbles which form a tough vapour-tight blanket over any surface of burning oil or petrol. It is characteristic of Nicerol Foam that it flows with the fire and is highly resistant to flash-back or re-ignition. It can be used successfully in any type of mechanical foam or air-foam apparatus—is equally effective with ***salt*** water or ***fresh*** and can be stored for years without deterioration.

★ **The Royal Navy and the Royal Air Force use it and so do Oil Companies, Fire Equipment Manufacturers, Civil Air Lines, several Commonwealth and Foreign Government departments, and Fire Brigades throughout the world. What better recommendation.**

★ **Nicerol is supplied in new heavy gauge steel drums specially designed to permit quick release and clean pouring of contents. These are supplied in 2, 5 or 40 Imperial Gallons capacity. 3 gallons of Nicerol will produce over 1,000 gallons of pure white foam.**

NICEROL LIMITED

LISBURN (Telephone 2027 Telegrams: Nicerol, Lisburn) **N. IRELAND**

(Associated with the Burnhouse Organisation)

FOR CHEMICALS TO SPECIFICATIO

The Analytical Control Laboratories at Da

Insist on

M&B

Laboratory control by our own analysts for the basis of our service to the user of M& Laboratory Chemicals and Reagents. Up- date facilities for this work enable us to offe range which maintains consistently hi standards of purity in accordance with ri specifications. These specifications, which a clearly set out on the containers, have be selected to meet a wide variety of laborato procedures.

Over 500 different chemicals are available f prompt despatch from pre-packed stoc Presentation in specially designed contain ensures maximum protection at all times.

* *trade mark*

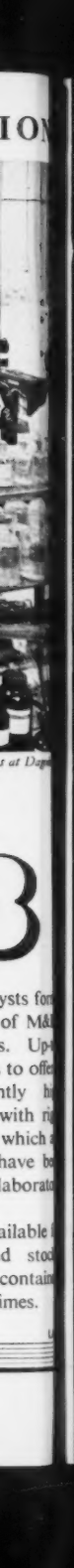
M&B *brand* LABORATORY CHEMICALS AND REAGENTS

manufactured by

MAY & BAKER LTD · DAGENHAM · ENGLAND

Tel. ILFord 3060 *Ext.* 40

Richmond Hill Printing Works, Ltd., 23-25, Abbott Road, Bournemouth



FOR
30 YEARS
WE HAVE
SERVED THE
OIL TRADE
EXCLUSIVELY.

ECLIPSOL OIL CO. LTD.

WHOLESALE MANUFACTURERS AND BLENDERS

ROEBUCK LANE, WEST BROMWICH

PHONE
WEST BROMWICH 0431-2-3-4

GRAMS :
SOLUBLE, WEST BROMWICH

LEAK-PROOF

TAMPER-PROOF

Tri-Sure

CLOSURE

Leading Drum-makers fit "Tri-Sure" Supplies immediately available from

VAN LEER INDUSTRIES LTD. 17 WATERLOO PLACE, PALL MALL, LONDON